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(54) IMPROVEMENTS IN OR RELATING TO APPARATUS FOR AND A METHOD OF EMBOSSING A PLASTICS SURFACE OF A BODY MADE WHOLLY OR PARTLY OF PLASTICS MATERIAL

(71) We, BRITISH INSULATED CALLENDER'S CABLES LIMITED, a British Company, of 21 Bloomsbury Street, London, W.C.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for and a method of embossing an elongated plastics-walled tubular body, such as an electric cable sheath or pipe, as it advances in the direction of its length. The invention has especial application to the embossing of information (e.g. voltage rating and the maker's name) upon electric cable coverings of synthetic plastics material but it is to be understood that it may be applied to the embossing of cable coverings of rubber or rubber-like material in an uncured or partially cured state and for the purposes of the specification such materials will be included where appropriate in the term "plastics".

The term "embossing" as used in this specification means the formation of an upstanding design on the external plastics surface of a body.

It is the general practice when embossing information upon a plastics covering of an electric cable to emboss the covering whilst it is in a hot, highly plastics state immediately after the plastics-covered cable emerges from an extrusion head but before it enters a cooling trough or other treatment vessel in which the embossed plastics covering is gradually strengthened. One common method of continuously embossing a plastics-covered cable immediately after it emerges from an extruder head is to pass the cable under an embossing wheel having in its outer circumferential surface indentations defining the insignia to be embossed upon the plastic covering. Where these indentations define lettering such lettering is, of course, reversed in the usual manner of a printing surface.

We have found that embossing wheels that have proved to be quite satisfactory for embossing elongated plastics-walled tubular bodies in which the plastics wall or covering is formed of polyvinyl chloride or low density polythene are unsatisfactory in the case where the wall or covering is formed of certain other plastics materials, for example high density polythene—by which is meant polythene having a density within the range 0.93 to 0.96 gm/cm^3—as after the cooling or other treatment of the wall or covering of such plastics materials the embossed information frequently becomes illegible and sometimes is even completely eliminated. This we believe to be due to the greater degree to which these plastics materials contrast during such cooling or other treatment and their stronger elastic memory and, when in a plastic state, to their higher viscosity.

By the present invention we provide an improved method of and apparatus for embossing an elongated plastics-walled tubular body as it advances in the direction of its length which enables satisfactory insignia to be obtained even in the case of bodies whose wall is of a plastics material having a high degree of contraction on cooling or a strong elastic memory.

According to the invention our improved method comprises causing the advancing elongated body with its wall in a plastic state to be continuously contacted by an embossing wheel having a circumferential embossing surface which has a plurality of circumferentially spaced indentations each of which defines insignia to be embossed upon the plastics wall and has in its boundaray wall a passage through which air from the indentation is expelled as the plastics material of the wall seals the rim of, and commences to fill, the indentation thereby permitting the plastics material to fill the indentation to a sufficient extent to ensure that, after strengthening of

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the plastics wall, the embossed insignia remains legible.

In providing a passage for the escape of air from the or each indentation the plastics material of the wall in its plastics state is permitted to enter the indentation to a depth sufficient to ensure that a legible embossed insigna remains after the plastics wall has been strengthened. As a consequence the pressure that might otherwise have had to be imparted on the plastics wall by the embossing device in order to ensure that the or each indentation is filled to the necessary depth is considerably reduced, thereby substantially eliminating any possibility of the plastics wall being deformed to an undesirable extent.

Where it is desired to expedite the abstraction of air from the or each indentation, as may be the case when the embossed insignia are of extra large volume and/or when the plastics material is a polythene of an extra high density, preferably each indentation is connected by a passage extending through the circumferential wall of the wheel to a chamber bounded wholly or in part by the wheel and, as the plastics material of the wall successively seals the rim of, and commences to fill, each indentation, air is continuously evacuated from the chamber to create a vacuum in the sealed indentation thereby permitting the plastics material of the wall to fill the indentation to a sufficient extent to ensure that, after strengthening of the plastics wall, the embossed insignia remains legible.

The invention also includes apparatus for carrying out the latter method of the invention, which apparatus comprises an embossing wheel whose outer circumferential surface is continuously in engagement with the plastics wall of the advancing body and has a plurality of circumferentially spaced indentations each of which defines insignia to be embossed upon the plastics wall and which has a passage extending through the circumferenial wall of the wheel and connecting the indentation to a chamber whose boundary wall is constituted wholly or in part by the wheel, means for temporarily sealing at any one time the passages of some or all of the indentations not in contact with the advancing body and, connected to the chamber, means for continuously evacuating air from each indentation as the plastics wall of the advancing body seals the rim of, and commences to fill, the indentation.

The embossing wheel may have associated therewith a rotatable device for engaging the opposite side of the advancing tubular body to that engaged by the embossing wheel. Preferably the embossing wheel is mounted on a horizontal spindle to bear on an upper part of the tubular body and the rotatable device comprises a wheel mounted on a horizontal spindle and grooved to engage and bear against a lower part of the tubular body. Where the rotatable device comprises a grooved wheel the grooved wheel preferably also constitutes an embossing wheel, the arrangement being such that the plastics covering of the tubular body is embossed along two diametrically opposed parts of its periphery. The upper embossing wheel may bear on the tubular body only under its own weight or the pressure generated by the force of gravity may be assisted, or relieved, and the lower embossing wheel caused to bear against the tubular body, by auxiliary means such as a counterweight or spring.

In order that the invention may be more fully understood and readily put into practice three forms of wheel for embossing, by the method of the invention, a plastics covering of an electric cable as the cable advances in the direction of its length with its covering in a highly plastic state will now be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a view partly in section and partly in elevation of one form of embossing wheel;

Figure 2 is a fragmental diagrammatic perspective view of apparatus for use in the manufacture of plastics covered electric cable incorporating two embossing wheels of the form shown in Figure 1;

Figure 3 is a fragmental view partly in section and partly in elevation of a second form of embossing wheel and spindle therefor, and

Figure 4 is a sectional view of an embossing wheel in accordance with the invention.

The embossing wheel shown in Figure 1 is made of metal and comprises a flat annulus 1 of circular cross-section which, at one of its edges, has an integral, radially inwardly directed flange 2 defining an end wall having a centrally located aperture 3. Integral with and projecting axially from the centrally located aperture 3 is an open-ended tubular stub shaft 4 which can be secured to a rotatably mounted spindle (not shown) by means of a grub screw. The outer surface of the annulus 1 constituting the circumferential wall of the wheel is of concave form and has, mid-way between the end walls of the annulus, a circumferential land 7 upstanding from the concave, circumferential surface of the wheel. The circumferential surface of the land 7 constitutes the embossing surface of the wheel and has formed therein a plurality of spaced, reversed letter indentations 8 specifying the name of the cable manufacturer and the voltage rating of the cable to be embossed. Associated with, and at the opposite ends of, each separate letter indentation 8 is a pair of grooves 9 in the embossing surface of the land 7, each of which grooves has a depth approximating to

the depth of the letter indentation and extends between the letter indentation and the neighbouring radially extending face of the land to constitute a passage for escape of air from the indentation as the plastics covering of the advancing cable seals the rim of, and commences to fill, the indentation.

In the apparatus for use in the manufacture of plastics covered electric cable shown in Figure 2 a cable core 11 travelling in the direction of its length in a substantially horizontal plane passes through an extruder 14 which applies an outer covering 12 of high density polythene to the cable core. On emerging from the extruder 14 with the polythene covering 12 in a highly plastic state the cable core 11 travels between a pair of embossing wheels 15 running on upper and lower parts of the covering and through a weir 16 into a trough 17 of cooling water by which the embossed covering is gradually strengthened. Each embossing wheel 15 is of the form shown in Figure 1 and is secured to a spindle 18 which extends transversely to the direction of travel of the cable and projects from one end of an arm 19 pivotally attached to an upstanding support 20 secured to a side wall of the trough 17. At the end of each arm 19 remote from the spindle 18 is a counterweight 21 whose position relative to the pivotting axis can be adjusted to permit limited variation of the force at which the embossing wheel 15 bears on or against the polythene covering 12.

Figure 3 shows an alternative form of embossing wheel which is especially suitable for embossing cable coverings of polythene of very high density. The wheel comprises a flat annulus 31 of circular cross-section which, at one of its edges, has an integral radially inwardly directly flange 32 defining an end wall having a centrally located aperture and which, at its other end, is closed by an end plate 40 hermetically sealed to the annulus by an "O" ring seal 41. Integral with and projecting axially from the centrally located aperture in the end wall 32 is an open-ended tubular stub shaft 34 which is secured to a hollow cantilevered spindle 35 rotatably mounted between a pair of bearings 42 in a housing 43.

The part of the spindle 35 between the pair of bearings 42 and a spacing ring 44 maintaining the pair of bearings in spaced relationship have, respectively, a plurality of circumferentially spaced holes 45 and 46 which provide access to a chamber 47 formed between the pair of bearings. In the wall of the housing 43 and opening into the chamber 47 is an internally screw-threaded aperture 48 into which is secured one end of a flexible tube 49 connecting a vacuum pump (not shown) to the chamber. The housing 43 is integral with, or is secured to, one end of a pivoted arm 19 which is of a form similar to the pivoted arm shown in Figure 2 and which has an adjustable counterweight at its other end.

The outer surface of the annulus forming the circumferential wall of the wheel is of concave form and constitutes the embossing surface. This surface has formed therein a plurality of spaced, reversed letter indentations 38 specifying the name of the cable manufacturer and the voltage rating of the cable to be embossed. Each separate letter indentation has at least one passage 39 extending through the circumferential wall of the wheel and connecting the indentation to the chamber 37 bounded by the circumferential and end walls of the wheel.

In operation, while a plastics-covered cable to be embossed is emerging from an extruder head with its plastics covering in a highly plastic state and an upper and a lower part of the covering are contacted by a pair of embossing wheels of the form shown in Figure 3, air is continuously evacuated from the chamber 37 bounded by each embossing wheel. As a letter indentation 38 in the circumferential surface of each wheel comes into contact with the plastics-covered cable and plastics material seals and commences to fill the indentation the pressure difference between the evacuated chamber 37 and the indentation is sufficient to cause the air in the indentation to flow via the passage or passages 39 into the chamber and along the hollow spindle 35, from which it is withdrawn by the vacuum pump, and so create a vacuum in the indentation thereby permitting the plastics material of the covering to fill the indentation to a sufficient extent to ensure that, after strengthening of the plastics wall, the embossed insignia remains legible.

In the case where an embossing wheel of the form shown in Figure 3 has a large number of separate indentations 38 spaced around its periphery only one or two of these indentations will be in contact with, and hence sealed by, the plastics covering of an advancing cable at any one time. Consequently although air is being continuously evacuated from the chamber 37, at the same time air will be continuously entering the chamber through the passages 39 of the indentations 38 not in contact with the plastics covering. Although in most cases a suitably-sized vacuum pump can be used to ensure that a sufficiently low pressure is created in the chamber 37 for air to flow into the chamber from an indentation 38 sealed by the plastics covering of a cable, there may be occasions when the number of indentations not in contact with and sealed by the plastics covering and the bore of the associated passage or passages 39 of each indentation are so great as to render difficult maintaining of a sufficiently low pressure in the chamber 37. Accordingly in such cases

the embossing wheel may include means for temporarily sealing at any one time the passages 39 of some or all of the indentations 38 not in contact with the cable.

The embossing wheel shown in Figure 4 is of a form similar to that shown in Figure 3 but includes such a temporary sealing means. This sealing means takes the form of a stationary screen 50 of arcuate form which is secured to an extension of a fixed hollow spindle 55 on which the wheel is rotatably supported by roller bearings 56. The arcuate surface of the stationary screen 50 carries a layer 51 of suitable self-lubricating material over which the inner circumferential surface of the embossing wheel slides as the wheel rotates, this screen at any one time sealing the passages 39 of a major proportion of the indentations 38 not in contact with the plastics covering.

In an alternative modified embossing wheel, not shown, the circumferential wall of the wheel may bound a blind bore into which fits a fixed hollow spindle which constitutes the chamber and on which the wheel rotates. The fixed hollow spindle has in the part of its outer circumferential surface nearer the cable to be embossed an orifice which opens into the bore of the spindle. As each indentation comes into contact with the plastics covering of an advancing cable its associated passage or passages overlies or overlie the orifice in the wall of the fixed spindle. The hollow spindle is continuously evacuated so that each indentation is only connected to the evacuated chamber via its associated passage or passages during the period in which it is in contact with the plastics covering.

Embossing wheels in accordance with the invention are especially suitable for use in embossing identification insignia upon the smooth outer surface of a high density polythene covering on a corrugated aluminium cable sheath.

WHAT WE CLAIM IS:—

1. A method of embossing an elongated plastics walled tubular body as it advances in the direction of its length, which method comprises causing the advancing elongated body with its wall in a plastic state to be continuously contacted by an embossing wheel having a circumferential embossing surface which has a plurality of circumferentially spaced indentations each of which defines insignia to be embossed upon the plastics wall and has in its boundary wall a passage through which air from the indentation is expelled as the plastics material of the wall seals the rim of, and commences to fill, the indentation thereby permitting the plastics material to fill the indentation to a sufficient extent to ensure that, after strengthening of the plastics wall, the embossed insignia remains legible.

2. A method of embossing an elongated plastics walled tubular body as it advances in the direction of its length, which method comprises causing the advancing elongated body with its wall in a plastic state to be continuously contacted by an embossing wheel having a circumferential embossing surface which has a plurality of circumferentially spaced indentations, each of which defines insignia to be embossed upon the plastics wall and has a passage extending through the circumferential wall of the wheel and connecting the indentation to a chamber bounded wholly or in part by the wheel and, as the plastics material of the wall successively seals the rim of, and commences to fill, each indentation, continuously evacuating air from the chamber to create a vacuum in the sealed indentation thereby permitting the plastics material of the wall to fill the indentation to a sufficient extent to ensure that, after strengthening of the plastics wall, the embossed insignia remains legible.

3. A method of embossing an elongated plastics walled tubular body as it advances in the direction of its length, which method comprises causing the advancing elongated body with its wall in a plastic state to be continuously contacted by an embossing wheel having a circumferential embossing surface which has a plurality of circumferentially spaced indentations, each of which defines insignia to be embossed upon the plastics wall and has a passage extending through the circumferential wall of the wheel and connecting the indentation to a chamber bounded wholly or in part by the wheel and having means for temporarily sealing at any one time the passages of some or all of the indentations and, as the plastics material of the wall successively seals the rim of, and commences to fill, each indentation, successively temporarily sealing the passages of some or all of the indentations not in contact with the advancing body and continuously evacuating air from the chamber to create a vacuum in the indentation sealed by the plastics material thereby permitting the plastics material of the wall to fill the indentation to a sufficient extent to ensure that, after strengthening of the plastics wall, the embossed insignia remains legible.

4. Apparatus for embossing by the method claimed in Claim 3 an elongated plastics walled tubular body as it advances in the direction of its length, which apparatus comprises an embossing wheel whose outer circumferential surface has a plurality of circuferentially spaced indentations each of which defines insignia to be embossed upon the plastics wall and which has a passage extending through the circumferential wall of the wheel and connecting the indentation to a chamber whose boundary wall is constituted wholly or in part by the wheel, means for temporarily sealing at any one time the pass-

ages of some or all of the indentations not in contact with the advancing body and, connected to the chamber, means for continuously evacuating air from each indentation as the plastics wall of the advancing body seals the rim of, and commences to fill, the indentation.

5. Apparatus as claimed in Claim 4, wherein the temporary sealing means comprises a stationary screen of arcuate form over which the inner circumferenital surface of the wheel slides as the wheel rotates, the arrangement being such that at any one time this screen effectively seals the passages of a major proportion of the indentations not in contact with the advancing body.

6. Apparatus as claimed in Claim 4 or 5, wherein the embossing wheel has associated therewith an embossing wheel of similar form engaging the opposite side of the advancing body to that engaged by the first embossing wheel.

7. Apparatus as claimed in any one of Claims 4 to 6, wherein the outer circumferential surface of the embossing wheel is of concave form.

8. A method of embossing an elongated plastics walled tubular body as it advances in the direction of its length substantially as hereinbefore described by way of example.

9. Apparatus for embossing an elongated plastics walled tubular body as it advances in the direction of its length substantially as hereinbefore described with reference to and as shown in Figure 3 or 4 of the accompanying drawings.

10. An electric cable having an outer covering of plastics material on which insignia have been embossed by the apparatus or method claimed in any one of the preceding Claims.

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Sheet 1

Fig. 1.

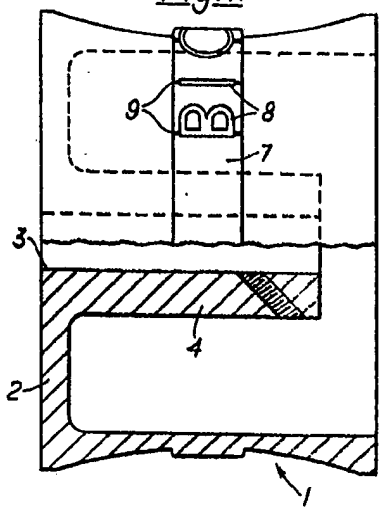

Fig. 4.

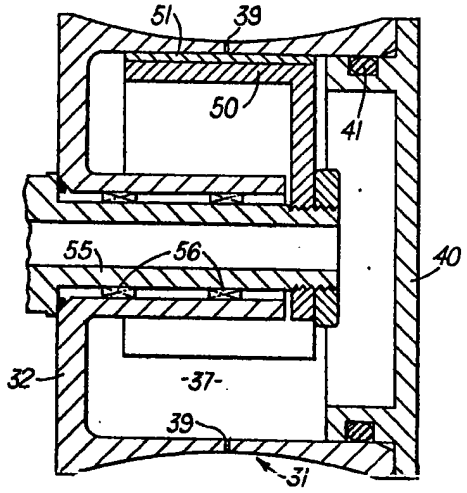

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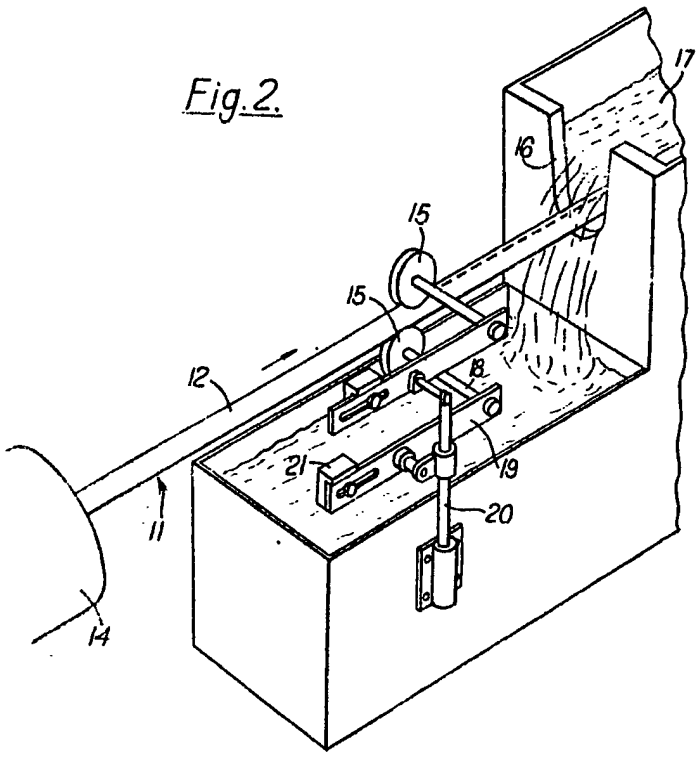
Fig.2.



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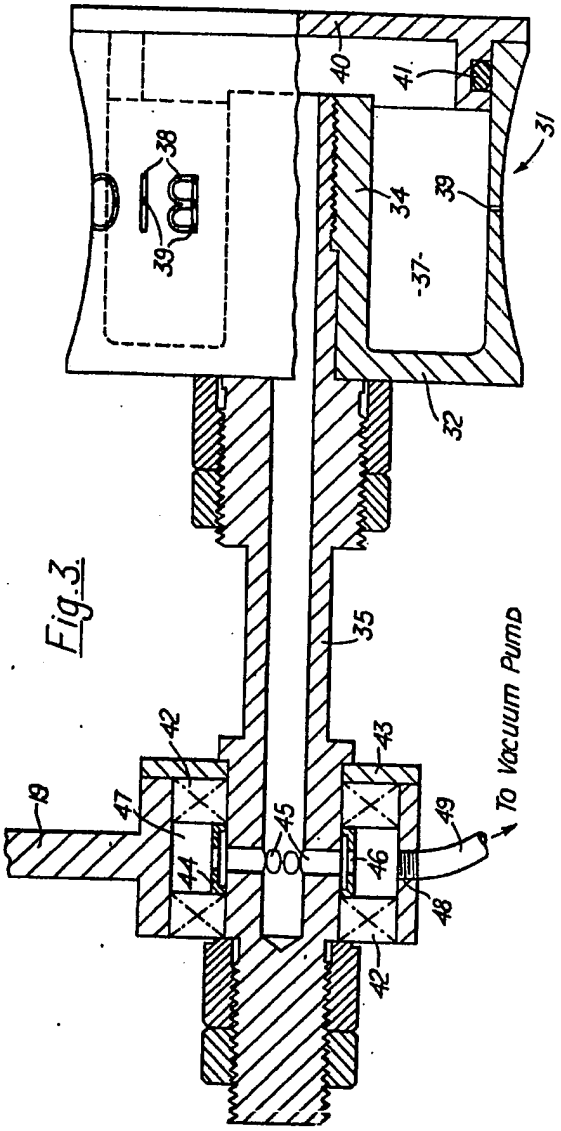

Fig.3.